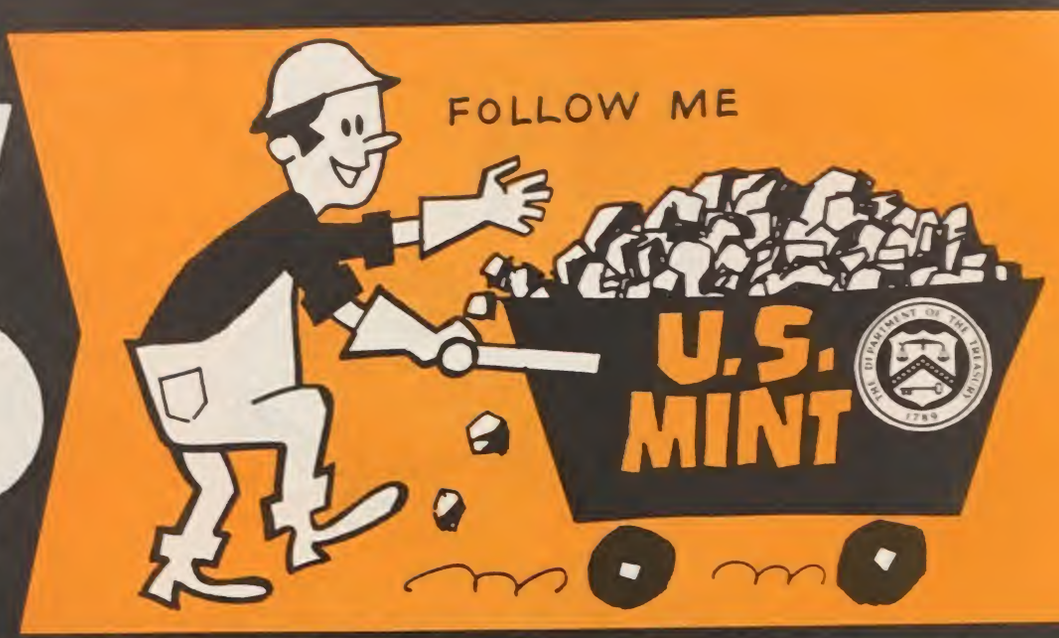
# RG 104, 8NS-104-94-077
# Box 7

8NS-104-94-077, Miscellaneous
Correspondence & Memos, 1897-1994

Production of Coins

# How TO MAKE A PENNY




## AT THE DENVER MINT

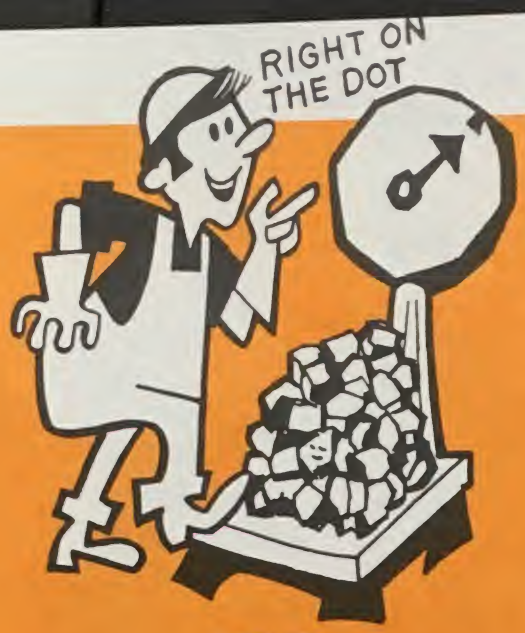
A lot of people save pennies. Many more people just put them in a drawer and forget about them. That's too bad. Pennies are needed in the world of business. If all the forgotten pennies were brought out of hiding and used, it would save the mint a lot of time and money making more and more pennies every year.

The penny is our country's most popular coin and the mint makes more pennies than any other coin. In fact, 76 percent of all the coins made each year are pennies. This year the mint plans to make 5½ billion pennies.

Pennies are made of two metals. They are 95 percent copper and 5 percent zinc. "Nickels" are also made of two metals. They are 75 percent copper but only 25 percent nickel. This alloy is called cupro-nickel.

All other coins are called composite coins because they are made in three layers. The outside layers are cupro-nickel and the middle layer is pure copper. Dimes, quarters and half-dollars all have three layers as does the new dollar coin first issued in the fall of 1971. The layers must be bonded together. This is called cladding.

The Act of April 2, 1792, provided for a national coinage and the establishment of the U.S. Mint. The first mint opened in Philadelphia and it was the first public building erected by the United States Government. The first coins made were pattern silver half dimes made by hand from silver belonging to George Washington. In 1793 copper cents and half cents were the first coins made for regular use.

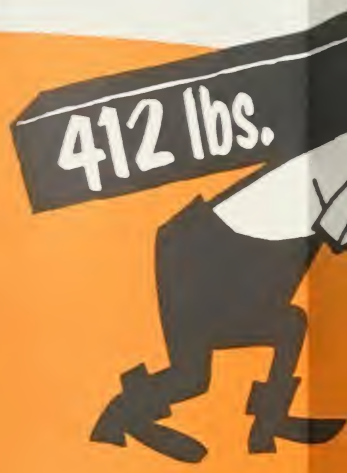



### MAKE-UP

The make-up box is weighed on a floor scale. It's called a make-up box because it holds the raw metal from which coins are made up. A big crane picks up the box and takes it to the melting furnace.

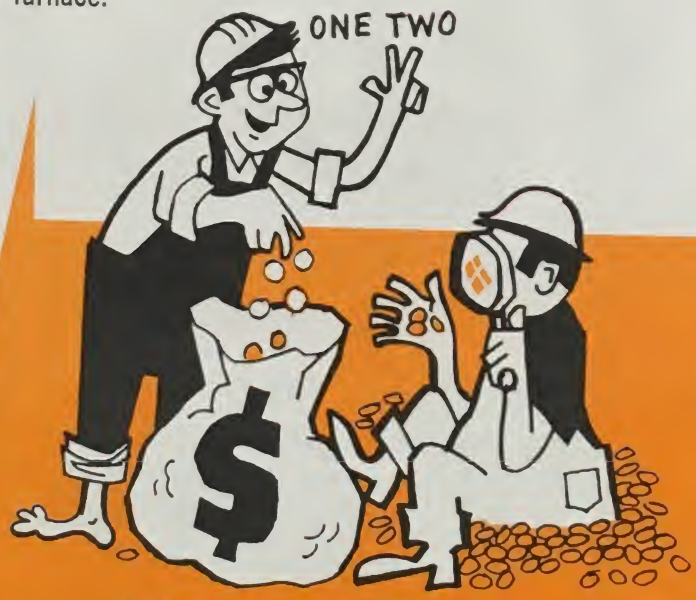

### MELTING

The furnace is electric and gets red hot. When the metal is put inside the furnace it melts. The furnace can hold 500 pounds of metal.



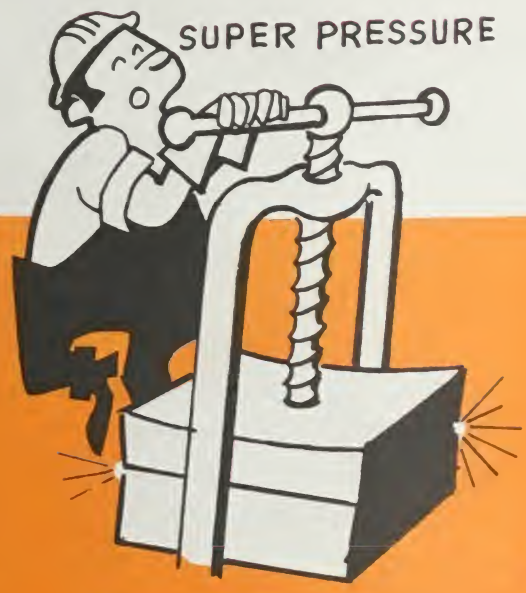

### CASTING

The melted metal is
mold that looks like a g
The bar is called an in
melted metal cools it g
The ingot is about 5'3"
and weighs about 412 po



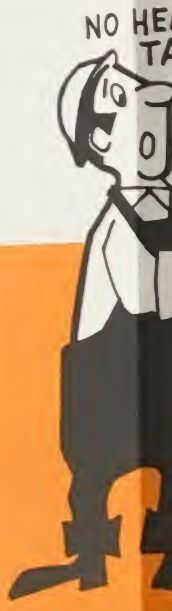

### INSPECTION, COUNTING AND BAGGING

At last we have a penny! Bad pennies are not allowed to leave the mint. Good pennies go to the counting machine. After 5,000 pennies fall into the bag a sewing machine sews the bag shut. The bags go to the Federal Reserve Bank. Then the pennies go to you.



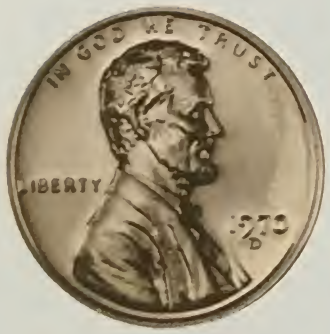

### COINING PRESS

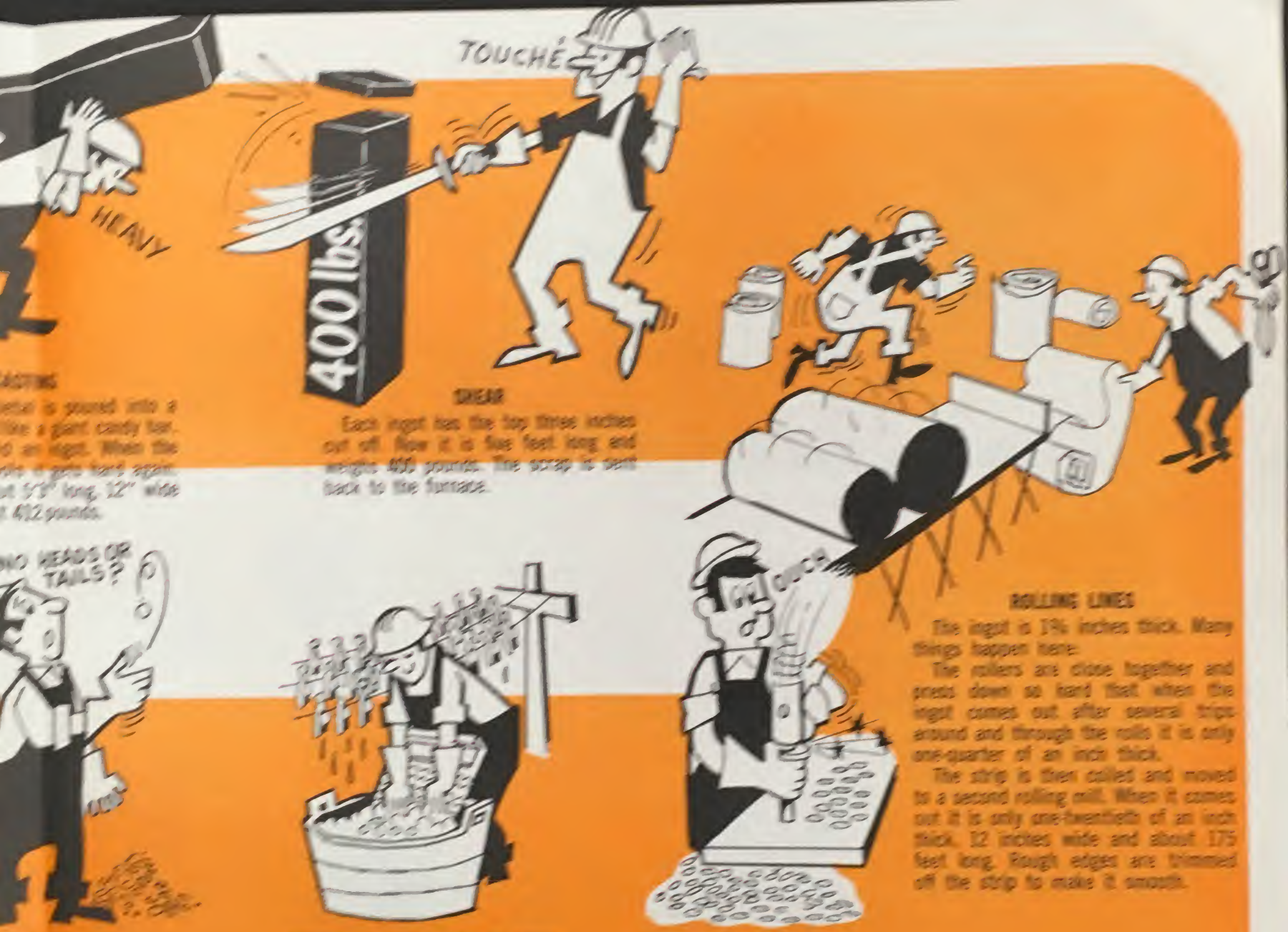
The shiny golden penny blanks are ready to receive the impression of President Lincoln's portrait on one side and the Lincoln Memorial on the other. The designs are impressed from hard steel coinage dies onto the blank. Fingers on the press firmly grab each blank and one heavy blow stamps the design on each side.




### UPSETTI

The blanks rol
through this mach
enough so that
presses on them it
the blanks.






### CASTING

...metal is poured into a ...like a giant candy bar. ...to an ingot. When the ...ingot is taken apart. ...it 5'3" long, 12" wide ...412 pounds.

### SHEAR

Each ingot has the top three inches cut off. Now it is five feet long and weighs 400 pounds. The scrap is sent back to the furnace.

### ROLLING LINES

The ingot is 3⅛ inches thick. Many things happen here.

The rollers are close together and press down so hard that when the ingot comes out after several trips around and through the rolls it is only one-quarter of an inch thick.

The strip is then coiled and moved to a second rolling mill. When it comes out it is only one-twentieth of an inch thick, 32 inches wide and about 175 feet long. Rough edges are trimmed off the strip to make it smooth.

### UPSETTING MILLS

...ks sit on their edges ...machine. They are soft ...then the machine ...it raises a rim around

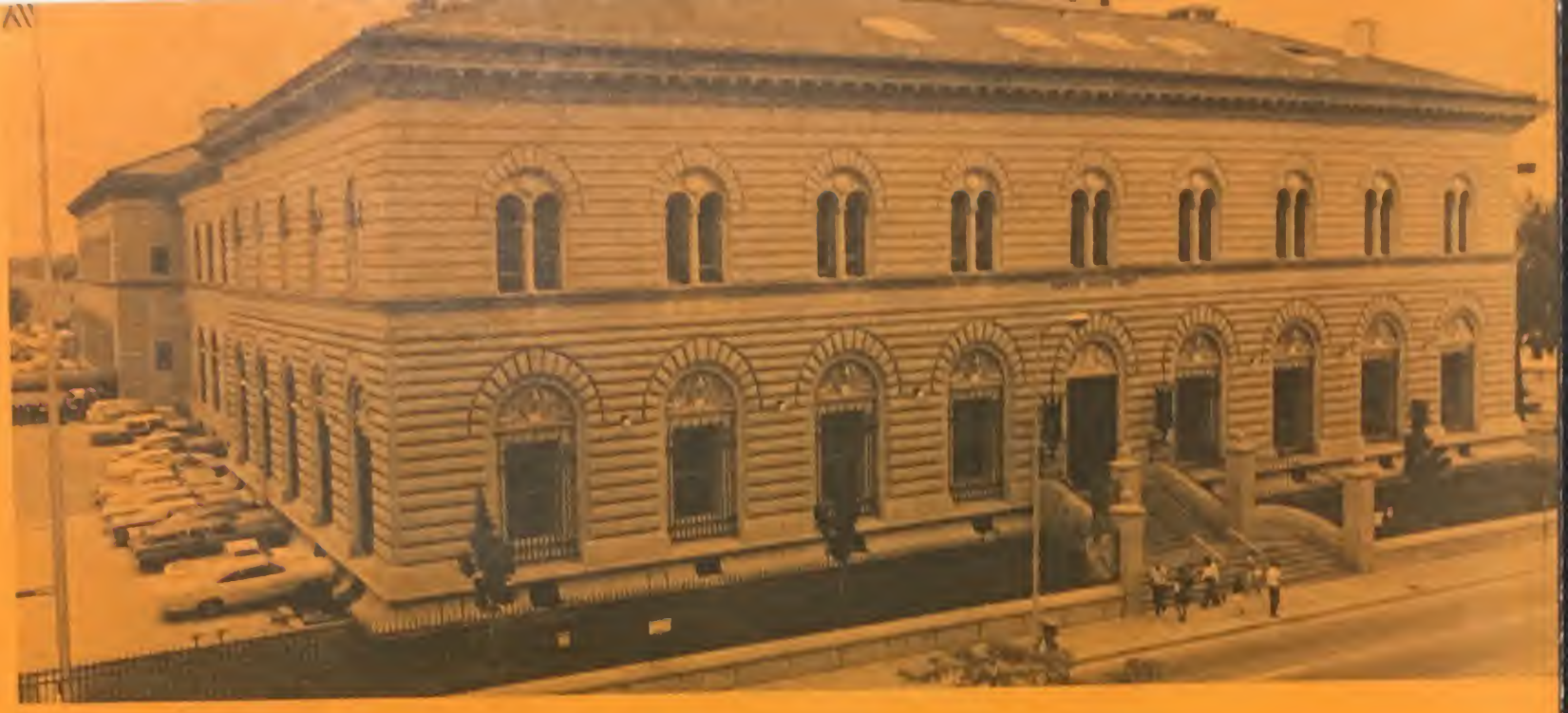
### ANNEALING AND CLEANING LINES

The blanks are put into a gas furnace to be softened again. (Annealing means to soften). They come out of the furnace red hot and drop into water to cool. The blanks are then cleaned and polished. Then they are rinsed off with water and dried.

### BLANKING PRESS

The strip is ready for punching out round pieces of metal about the size of a penny. They are called blanks, or planchets. This machine works just like a cookie cutter. After the blanks are punched out any strip left over is sent back to the make-up box.

★U.S. Government Printing Office: 1975-681-469



The Denver mint traces its history to the fall of 1862 when, for $25,000, the United States government purchased the private mint of Clark, Gruber & Co. at 16th and Market streets.

Although the Act of April 21, 1862, provided for the establishment of a Denver mint the facility first opened as an Assay Office. Its operations were restricted to melting, refining, assaying and stamping of gold bars as to fineness and weight which were formed from gold dust and nuggets brought in by miners in the surrounding area.

That was five years after Denver was founded in 1858, the year placer gold was discovered at the junction of the South Platte River and Cherry Creek, now the geographical center of the city. The following year lode gold was found. Colorado was organized as a Territory in 1861 and earned the nickname of the "Centennial State" in 1876 when, a hundred years after the signing of the Declaration of Independence, statehood was achieved.

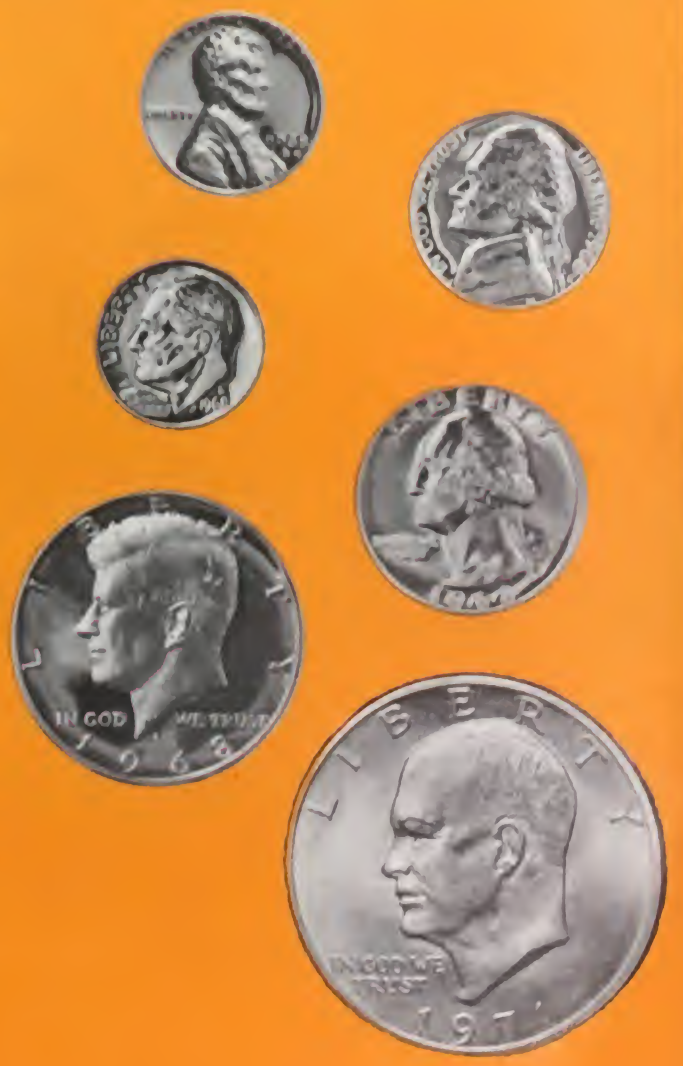
In 1895 Congress approved a mint for the coinage of gold and silver. The Assay Office moved to its present structure in 1904 and in February of 1906 advanced to the status of a U.S. mint when coinage operations began.

During the first year of operation, the mint turned out gold coin valued at 23.8 million dollars and silver coins valued at 3.2 million dollars. Coinage of five cent and one cent pieces began in 1911 and that year 12.6 million pieces were minted.

To meet the growing demand for coins, the present building was expanded in 1936 and new equipment installed to speed and perfect the manufacturing process. Again, in 1946 and 1965, new wings were added. Today the Denver mint is capable of producing 850,000 coins per hour.

Visitors are welcome at the Denver mint. One of the highlights of the tour is a display of gold bars worth over $1,000,000. Each bar weighs approximately 27½ pounds and is valued at $14,000.

The Denver Mint is a part of a nationwide Treasury Agency known as the Bureau of the Mint. From headquarters in Washington, D.C., the Director of the Mint administers the Philadelphia and Denver Mints, the Assay Offices at New York City and at San Francisco and the Depositories at Fort Knox, Ky. and West Point, N.Y. for the storage of gold, silver and other coinage metals.



March 1, 1955

Denver Mint

COINING METHODS

Coinage ingots are received by the Coining Division from the Melting & Refining Division without transfer weighing. The Coining Division receives all current production of the ingot melting room.

The rolling room is equipped with two 18" Lewis mills powered with Westinghouse 350 H.P. synchronous motors. For handling material at break down mill a system of roller conveyors is employed consisting of two racks for loading ingots and slabs, a reversable motorized chain driven entry conveyor for ingots and strips entering mill,a belt driven runout conveyor, a cross over chain driven conveyor with lugs for accommodating 4 slabs, a chain driven return conveyor and a transfer wheel at end of return conveyor accommodating six slabs, which returns slabs to the entry conveyor. Slabs and finished strips are removed from runout conveyor into a rack at side of conveyor by employment of driven chains with lugs. These chains are also used to move the slabs and strips onto the cross over conveyor from the runout conveyor and are an integral part of it. Finished strips are taken from rack of break down mill runout conveyor by use of a multiple lift fork and bridge crane. Slabs for annealing are picked from rack by means of an I-beam sling with chains using a bridge crane and placed on a transfer car having a belt driven roller bed, for removal to slab and coil annealing furnace located on opposite side of room. From the transfer car the slabs progress along a belt driven roller conveyor located at side of furnace to the entry and for charging.

Ingots are processed thru break down mill, usually in rounds of twelve. Bronze strips from breakdown mill are transferred to storage rack for finish mill and are finished without annealing. Nickel and silver ingots are reduced to about 3/4" thickness and annealed in continuous roller-hearth gas-fired annealing furnace manufactured by the Electric Furnace Co. The rated output for this furnace is 5,000 pounds of metal per hour. The annealed slabs of nickel and silver undergo further reduction on the roughing mill to a gauge of about 0.225" and are then transferred to storage rack of finish mill for coiling and subsequent annealing at a gauge of about 0.190", after which the annealed coils are finished to proper gauge for various denominations.

The conveyor system for the finish mill consists of a roller entry conveyor having a chain driven motorized section, and a circular gravity roller conveyor for coil return to the entry side of the mill. The strips pass thru the mill into a Lewis upcoiler from which they are ejected into a roller cradle by means of an air cylinder. This cradle is elevated by means of an air cylinder and coils roll onto the gravity return conveyor. This circular conveyor holds about 40 coils. The annealed coils are moved to the finish mill from the coil storage conveyor area by means of a

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portable roller cross over conveyor. The entire area where roughing mill and finish mill are located is serviced by 3 bridge cranes, a 1½ ton, a 3 ton, and a 5 ton.

The finished coils are removed from the finish mill gravity conveyor by use of a bridge crane and hook and are piled in a storage area near the slitter. The finished coils which are about 12½" wide are transfered from storage pile to a cradle equipped with rollers by use of a job crane and hook, from which they uncoil thru the slitter which trims the edges and slits the coil into two strips 5 7/8" wide. From the slitter the strips enter an upcoiler for recoiling and are then transfered by use of a jib crane and hook to the v-shaped ring storage racks in front of the punches.

Blanking is accomplished by use of 2 Bliss High speed blanking presses and 2 General Engineering high speed blanking presses. The rings are rolled from ring storage racks into uncoiling cradles equipped with rollers for entry into blanking presses.

As material is finished on the finish mill, test rings are blanked and sampled throughout the length of the ring. Prescribed samples are weighed to establish the gauge at which the entire round should be finished in order to keep within predetermined limits of standard so that individual blanks will be within legal weight tolerance. Following is a list of various denominations and predetermined limits.

| Denomination | Sample in Pieces | Limits | Std Weight |
|---|---|---|---|
| Bronze | 500 | ± 2 oz. | 50 oz. |
| Nickel | 500 | ± 2 oz. | 80.375 oz. |
| Dimes | 500 | ± .85 oz. - .40 oz. | 40.1875 oz. |
| Quarters | 400 | ± 2 oz. | 80.375 ozs. |
| Halves | 200 | ± 2 oz. | 80.375 oz. |

On bronze only test rings are sampled and blanks weighed.

On nickel and dimes all rings are ultimately sampled and blanks weighed and all blanks from ring are discarded if test sample is found to be outside of predetermined limits.

On quarters and halves using standard weight of test sample as dividing line, blanks are separated into three classes, which are, strip ends, lights and heavies. All rings are sampled and all blanks as determined from test sample are placed in appropriate class if within prescribed limit. If not within prescribed limits they are discarded. No sampling of blanks from strip ends is done as these blanks are not representative of whole strip.

The number of blanks cut at each punch press stroke is as follows: 8 cents, 7 nickels, 8 dimes, 6 quarters, and 5 halves.

Punched strip enters a rotary clip chopper at back of punch and clips fall from chopper into tote boxes placed on dolly underneath chopper. When these boxes are filled they are dumped into gondolas for return to Melting

and Refining Division without transfer weighing.

Cut blanks from the rolling room are weighed through the process weigh room after which they are sent to the annealing & cleaning room or to storage if excess blanks are being produced.

The annealing & cleaning room is equipped with 2 American gas furnaces No. 139-S and 2 lines of Ransohoff cleaning equipment. Furnace hoppers are filled from tote boxes by use of a bridge crane and blanks from dryers are discharged into gondolas.

The annealed and cleaned blanks are sent to the upsetting section without being weighed thru the process weigh room. The upsetting section is located at one end of the press room and is equipped with 2 Bliss upsetting mills and 2 reconstructed Philadelphia made upsetting mills with Timken bearings. All mills are equipped with dual automatic horizontal disc feed. Feeders are loaded from a central hopper for each machine which is filled from chutes extending from the press room balcony. Chutes are filled by dumping annealed blanks into them from the balcony. Upset blanks fall from mills into tote boxes placed on roller conveyors so they can be rolled under a monorail crane for transference to hand trucks. They are then taken to review section without weighing through process weigh section.

The review room is equipped with 9 standard mint made review tables. The minor and dime reviewed blanks go to the process weigh room for weighing to the press room. The quarter and half dollar blanks go to the adjusting room for weighing thru the automatic scales without being weighed thru the process weigh room.

The automatic scale room has 6 ten-beam automatic scales, 4 of which are equipped with automatic feeders. Rails and feeders are available for installation on the other 2. Blanks are delivered in gondolas which are elevated onto tables and blanks are drawn into blank catching cans for charging into automatic feeders. Gondolas of blanks of lights and heavies are sampled top and bottom to extent of at least 5,000 pieces and run thru weighing machines to ascertain if there are any heavy condemned in the lights and any light condemned in the heavies. If no heavy condemned blanks are found in the sample from the lights, then the entire gondola of lights will be run for light condemned only. If no light condemned blanks are found in the sample of heavies, then the entire gondola of heavies will be run for heavy condemned only. In the event any light condemned blanks are found in the heavies, then the entire gondola will be run for light and heavy condemned. The same will apply if any heavy condemned blanks are found in the sample of lights. Adjusted blanks are dumped into tote boxes on hand trucks for delivery to process weigh room where they are weighed either into storage or for stamping. Condemned blanks are also dumped into tote boxes for return to process weigh section for subsequent delivery to the Melting & Refining Division.

The press room is equipped with 22 presses, 20 of which may be used for

stamping any denomination from ce t to dollar, 2 may not be used for stamping coins larger than quarter dollars. 21 presses may be used for dual stamping for cents and dimes. Feeding equipment is on hand for dual stamping of nickels on 9 presses, dimes on 12 presses, and cents on 21 presses. This equipment is probably sufficient for most any combination coinage program which might be called for. Production of cents, nickels and dimes is 100% by dual stamping. Blanks are delivered to press room balcony by process weigh room in gondolas. These gondolas are dumped into chutes extending into the press room from the balcony. There are six chutes on East side of room servicing 12 presses and 4 chutes on West side of room to service 10 presses. Blanks are drawn from chutes into circular screen bottomed containers supported on racks equipped with castors for movement to presses. Containers hold about 2,500 ounces of blanks which are fed by scoop to feederhoppers on the presses. Stamped coins at presses are handled in coin boxes. These boxes of coin are dumped into tote boxes for subsequent handling. Minor coin goes directly to the counting section without process weighing. Silver is weighed in the Process Weigh Room and then routed to the counting section. Four of the presses on the East side of the press room are equipped with enlarged press feed hoppers and coin catch traps. Coin from these presses is dumped into tote boxes on dollies at the side of the press. Full tote boxes of coin are rolled a short distance to a position under an electric hoist and are lifted from the dollie and dumped into standard tote boxes on hand trucks. Similar equipment is to be installed for the remainder of the presses in the press room.

The counting section is equipped with 8 Abbott counting machines placed on steel stands, 2 to a stand with an elevated hopper feeding into syntron vibrators which feed each counting machine. Minor coins for counting comes directly from the press room while silver coin comes from the process weigh room to the counting section. Coin is counted directly into bags, $50.00 denominations of silver (#1 bags). Two counting machines have a common portable sack sewing machine used for sewing closure of the bagged bronze voin instead of sealing the bags. Bagged coin is weighed in drafts of 15 bags for bronze and 10 bags for each of the other denominations using a predetermined tare weight for the weight of bags & seals or thread. A 10,000 ounce scale is used for weighing bagged coin. Hoppers on counting machine stands are filled from tote boxes using a bridge crane for dumping. Bagged coin for delivery to the Cashier is stacked on pallets placed on hand trucks, 60 bags on cents, 40 bags on nickels and 45 bags on silver.

The process weigh room is equipped with one 10,000 ounce scale and 2 bridge cranes for handling weigh tubs on and off the balance. The standard draft for all denominations is 10,000 ounces. Blanks to the presses are controlled in locked gondolas.

## METHOD OF RECORDING LIFE OF DIES

An individual die card is issued with each die as it is put into service - information shown on each card as follows: denomination, die number, date issued, die setter, remarks, date retired, by whom retired and by whom checked.

The record cards are kept in a numbered rack from the time each die is issued until it is retired.

When a new set of dies is put into service the required information is entered on the record card by the die setter and checked by the foreman. The counter on the press is set at zero & the cards are placed in the rack. When the dies are retired the die setter enters the pieces struck as shown by the counter and he is checked by the foreman. If any of the dies are retired before the rest, entries are made on the cards just the same and the cards for the retained dies are returned to the rack. The counter on the press is turned back to zero and the additional pieces struck entered on the card when the die or dies are finally retired.

Each day the foreman of the press room turns in the record cards for all dies retired to the Coining Division office where the permanent record of all coinage dies is kept in the Record of Coinage Dies, Form 864.

As shipments of dies are received from the Philadelphia Mint the die numbers are posted in the permanent record. After the dies are used, the number of pieces struck by each die and the date retired are entered from the individual die record card as received from the foreman of the press room.

An intermediate posting to a loose-leaf form is made for convenience in compiling a monthly die report. The quarterly die reports are made from the permanent die record.

## DESTRUCTION OF DIES

Retired dies are destroyed quarterly, and in addition all unused obverse dies are destroyed at the end of the calendar year.

Lists of dies to be destroyed are prepared in advance from the permanent die record and copies of these lists are given to the Superintendent and the Assayer.

The foreman of the press room arranges the dies in boxes in the order they appear on the lists to facilitate checking. The Assistant Superintendent of the Coining Division arranges for the destruction of the dies in the presence of the Superintendent and the Assayer or their designated representatives. Dies are checked off the list individually by number and are destroyed by melting the face and neck of each die with an electric welder. Two copies of the official report are then checked from the lists and signed by the Superintendent, the Assayer and the Superintendent of the Coining Division.

COPY



~~March 1, 1955~~
Nov 2, 1962

Denver Mint

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The annealed and cleaned blanks are sent to the upsetting section without being weighed thru the process weigh room. The upsetting section is located at one end of the press room and is equipped with 2 Bliss upsetting mills and 2 reconstructed Philadelphia made upsetting mills with Timken bearings. All mills are equipped with dual automatic horizontal disc feed. Feeders are loaded from a central hopper for each machine which is filled from chutes extending from the press room balcony. Chutes are filled by dumping annealed blanks into them from the balcony. Upset blanks fall from mills into tote boxes placed on roller conveyors so they can be rolled under a monorail crane for transference to hand trucks. They are then taken to review section without weighing through process weigh section.

gondolas and or

The review room is equipped with ~~9~~ 4 standard mint made review tables. The minor and dime reviewed blanks go to the process weigh room for weighing to the press room. The quarter and half dollar blanks go to the adjusting room for weighing thru the automatic scales without being weighed thru the process weigh room.

The automatic scale room has 6 ten-beam automatic scales, ~~4~~ 5 of which are equipped with automatic feeders. Rails and feeders are available for installation on the other 1. Blanks are delivered in gondolas which are elevated onto tables and blanks are drawn into blank catching cans for charging into automatic feeders. Gondolas of blanks of lights and heavies are sampled top and bottom to extent of at least 5,000 pieces and run thru weighing machines to ascertain if there are any heavy condemned in the lights and any light condemned in the heavies. If no heavy condemned blanks are found in the sample from the lights, then the entire gondola of lights will be run for light condemned only. If no light condemned blanks are found in the sample of heavies, then the entire gondola of heavies will be run for heavy condemned only. In the event any light condemned blanks are found in the heavies, then the entire gondola will be run for light and heavy condemned. The same will apply if any heavy condemned blanks are found in the sample of lights. Adjusted blanks are dumped into ~~tote boxes or hand trucks~~ gondolas for delivery to process weigh room where they are weighed either into storage or for stamping. Condemned blanks are also dumped into tote boxes for return to process weigh section for subsequent delivery to the Melting & Refining Division.

The press room is equipped with ~~22~~ 29 presses, ~~20 of which~~ all 29 may be used for

stamping any denomination from ce t to dollar, ~~2 may not be used for stamping coins larger than quarter dollars~~. 29 presses may be used for dual stamping for cents and dimes. Feeding equipment is on hand for dual stamping of nickels on 9 presses, dimes on 12 presses, and cents on ~~21~~ 29 presses. This equipment is probably sufficient for most any combination coinage program which might be called for. Production of cents, nickels and dimes is 100% by dual stamping. Blanks are delivered to press room balcony by process weigh room in gondolas. These gondolas are dumped into chutes extending into the press room from the balcony. There are six chutes on East side of room servicing 12 presses and 4 chutes on West side of room to service 10 presses. Blanks are drawn from chutes into circular screen bottomed containers supported on racks equipped with casters for movement to presses. Containers hold about 2,500 ounces of blanks which are fed by scoop to feederhoppers on the presses. Stamped coins at presses are handled in coin boxes. These boxes of coin are dumped into tote boxes for subsequent handling. Minor coin goes directly to the counting section without process weighing. Silver is weighed in the Process Weigh Room and then routed to the counting section. Four of the presses on the East side of the press room are equipped with enlarged press feed hoppers and coin catch traps. Coin from these presses is dumped into tote boxes on dollies at the side of the press. Full tote boxes of coin are rolled a short distance to a position under an electric hoist and are lifted from the dollie and dumped into standard tote boxes on hand trucks. Similar equipment is to be installed for the remainder of the presses in the press room.

The counting section is equipped with ~~8~~ 10 Abbott counting machines placed on steel stands, 2 to a stand with an elevated hopper feeding into syntron vibrators which feed each counting machine. Minor coins for counting comes directly from the press room while silver coin comes from the process weigh room to the counting section. Coin is counted directly into bags, $50.00 denominations of silver (#1 bags). Two counting machines have a common portable sack sewing machine used for sewing closure of the bagged bronze coin instead of sealing the bags. Bagged coin is weighed in drafts of 15 bags for bronze and 10 bags for each of the other denominations using a predetermined tare weight for the weight of bags & seals or thread. A 10,000 ounce scale is used for weighing bagged coin. Hoppers on counting machine stands are filled from tote boxes using a bridge crane for dumping. Bagged coin for delivery to the Cashier is stacked on pallets placed on hand trucks, 60 bags on cents, 40 bags on nickels and 45 bags on silver.

The process weigh room is equipped with one 10,000 ounce scale and 2 bridge cranes for handling weigh tubs on and off the balance. The standard draft for all denominations is 10,000 ounces. Blanks to the presses are controlled in locked gondolas.

## METHOD OF RECORDING LIFE OF DIES

An individual die card is issued with each die as it is put into service - information shown on each card as follows: denomination, die number, date issued, die setter, remarks, date retired, by whom retired and by whom checked.

The record cards are kept in a numbered rack from the time each die is issued until it is retired.

When a new set of dies is put into service the required information is entered on the record card by the die setter and checked by the foreman. The counter on the press is set at zero & the cards are placed in the rack. When the dies are retired the die setter enters the pieces struck as shown by the counter and he is checked by the foreman. If any of the dies are retired before the rest, entries are made on the cards just the same and the cards for the retained dies are returned to the rack. The counter on the press is turned back to zero and the additional pieces struck entered on the card when the die or dies are finally retired.

Each day the foreman of the press room turns in the record cards for all dies retired to the Coining Division office where the permanent record of all coinage dies is kept in the Record of Coinage Dies, Form 864.

As shipments of dies are received from the Philadelphia Mint the die numbers are posted in the permanent record. After the dies are used, the number of pieces struck by each die and the date retired are entered from the individual die record card as received from the foreman of the press room.

An intermediate posting to a loose-leaf form is made for convenience in compiling a monthly die report. The quarterly die reports are made from the permanent die record.

## DESTRUCTION OF DIES

Retired dies are destroyed quarterly, and in addition all unused obverse dies are destroyed at the end of the calendar year.

Lists of dies to be destroyed are prepared in advance from the permanent die record and copies of these lists are given to the Superintendent and the Assayer.

The foreman of the press room arranges the dies in boxes in the order they appear on the lists to facilitate checking. The Assistant Superintendent of the Coining Division arranges for the destruction of the dies in the presence of the Superintendent and the Assayer or their designated representatives. Dies are checked off the list individually by number and are destroyed by melting the face and neck of each die with an electric welder. Two copies of the official report are then checked from the lists and signed by the Superintendent, the Assayer and the Superintendent of the Coining Division.

November 2, 1962

DENVER MINT

COINING METHODS

Coinage ingots are received by the Coining Division from the Melting and Refining Division without transfer weighing. The Coining Division receives all current production of the ingot melting room.

The rolling room is equipped with two 18" Lewis mills powered with Westinghouse 350 H.P. synchronous motors. For handling material at breakdown mill a system of roller conveyors is employed consisting of two racks for loading ingots and slabs, a reversable motorized chain driven entry conveyor for ingots and strips entering mill, a chain driven runout conveyor, a cross over chain driven conveyor with lugs for accommodating 4 slabs, a chain driven return conveyor and a transfer wheel at end of return conveyor accommodating six slabs, which returns slabs to the entry conveyor. Slabs and finished strips are removed from runout conveyor into a rack at side of conveyor by employment of driven chains with lugs. These chains are also used to move the slabs and strips onto the cross over conveyor from the runout conveyor and are an integral part of it. Finished strips are taken from rack of breakdown mill runout conveyor by use of a multiple lift fork and bridge crane. Slabs for annealing are picked from rack by means of a I-beam sling with chains using a bridge crane and placed on a transfer car having a belt driven roller bed, for removal to slab and coil annealing furnace located on opposite side of room. From the transfer car the slabs progress along a belt driven roller conveyor located at side of furnace to the entry and for charging.

Ingots are processed through breakdown mill, usually in rounds of twelve. Bronze strips from breakdown mill are transferred to storage rack for finish mill and are finished without annealing. Nickel and silver ingots are reduced to about 3/4" thickness and annealed in continous roller-hearth gas-fired annealing furnace manufactured by the Electric Furnace Co. The rated output for this furnace is 6,500 pounds of metal per hour. The annealed slabs of nickel and silver undergo further reduction on the roughing mill to a gauge of about 0.225" and are then transferred to storage rack of finish mill for coiling

and subsequent annealing at a gauge, as shown in rolling scheduled, after which the annealed coils are finished to proper gauge for various denominations.

The conveyor system for the finish mill consists of a roller entry conveyor having a chain driven motorized section, and a circular gravity roller conveyor for coil return to the entry side of the mill. The strips pass through the mill into a Lewis upcoiler from which they are ejected into a roller cradle by means of an air cylinder. This cradle is elevated by means of an air cylinder and coils roll onto the gravity return conveyor. This circular conveyor holds about 40 coils. The annealed coils are moved to the finish mill from the coil storage conveyor area by means of a portable roller cross over conveyor. The entire area where roughing mill and finish mill are located is serviced by 3 bridge cranes, a 1½ ton, a 2 ton, and a 5 ton.

The finished coils are removed from the finish mill gravity conveyor by use of a bridge crane and hook and are piled in a storage area near the slitter. The finished coils which are about 12½" wide are transferred from storage pile to a cradle equipped with rollers by use of a jib crane and hook, from which they uncoil through the slitter which trims the edges and slits the coil into two strips 5-7/8" wide. From the slitter the strips enter an upcoiler for recoiling and are then transferred by use of a jib crane and hook to the v-shaped ring storage racks in front of the punches.

Blanking is accomplished by use of 3 Bliss High speed blanking presses and 2 General Engineering high speed blanking presses. The rings are rolled from ring storage racks into uncoiling cradles equipped with rollers for entry into blanking presses.

As material is finished on the finish mill, test rings are blanked and sampled throughout the length of the ring. Prescribed samples are weighed to establish the gauge at which the entire round should be finished in order to keep within predetermined limits of standard so that individual blanks will be within legal weight tolerance. Following is a list of various denominations and predetermined limits.

| Denomination | Sample in Pieces | Limits | St'd. Weight |
|---|---|---|---|
| Bronze | 500 | ≠ 2 oz. | 50 oz. |
| Nickel | 500 | ≠ 2 oz. | 80.375 oz. |
| Dimes | 500 | ≠ 1.0 oz.- .80 oz. | 40.1875 oz. |
| Quarters | 400 | ≠ 2 oz. | 80.375 ozs. |
| Halves | 200 | ≠ 2 oz. | 80.375 oz. |

On bronze only test rings are sampled and blanks weighed.

On nickel and dimes all rings are ultimately sampled and blanks weighed and all blanks from ring are discarded if test sample is found to be outside of predetermined limits.

On quarters and halves using standard weight of test sample as dividing line, blanks are separated into three classes, which are, strip ends, lights and heavies. All rings are sampled and all blanks as determined from test sample are placed in appropriate class if within prescribed limit. If not within prescribed limits they are discarded. No sampling of blanks from strip ends is done as these blanks are not representative of whole strip.

The number of blanks cut at each punch press stroke is as follows: 8 cents, 7 nickels, 8 dimes, 6 quarters and 5 halves.

Punched strip enters a rotary clip chopper at back of punch and clips fall from chopper into tote boxes placed on dolly underneath chopper. When these boxes are filled they are dumped into gondolas for return to Melting and Refining Division without transfer weighing.

Cut blanks from the rolling room are weighed through the process weigh room after which they are sent to the annealing and cleaning room or to storage if excess blanks are being produced.

The annealing and cleaning room is equipped with 2 American gas furnaces No. 139-S and 2 lines of Ransohoff cleaning equipment. Furnace hoppers are filled from tote boxes by use of a bridge crane and blanks from dryers are discharged into gondolas.

The annealed and cleaned blanks are sent to the upsetting section without being weighed through the process weigh room. The upsetting section is located at one end of the press room and

is equipped with 3 Bliss upsetting mills and 3 reconstructed Philadelphia nods upsetting mills with Timken bearings. All mills are equipped with dual automatic horizontal disc feed. Feeders are loaded from a central hopper for each machine which is filled from chutes extending from the press room balcony; chutes are filled by dumping annealed blanks into them from the balcony. Upset blanks fall from mills into gondolas and/or tote boxes placed on roller conveyors as they can be rolled under a monorail crane for transference to hand trucks. They are then taken to review section without weighing through process weigh section.

The review room is equipped with 4 standard sized nods review tables. The nickel and dime reviewed blanks go to the process weigh room for weighing to the press room. The quarter and half dollar blanks go to the adjusting room for weighing through the automatic scales without being weighed through the process weigh room.

The automatic scale room has 6 two-beam automatic scales, 5 of which are equipped with automatic feeders. Rails and feeders are available for installation on the other 1. Blanks are delivered in gondolas which are elevated onto tables and blanks are drawn into blank catching pans for charging into automatic feeders. Gondolas of blanks of lights and heavies are sampled top and bottom to extent of at least 5,000 pieces and run through weighing machines to ascertain if there are any heavy condemned in the lights and any light condemned in the heavies. If no heavy condemned blanks are found in the sample from the lights, then the entire gondola of lights will be run for light condemned only. If no light condemned blanks are found in the sample of heavies, then the entire gondola of heavies will be run for heavy condemned only. In the event any light condemned blanks are found in the heavies, then the entire gondola will be run for light and heavy condemned. The same will apply if any heavy condemned blanks are found in the sample of lights. Adjusted blanks are dumped into gondolas for delivery to process weigh section where they are weighed either into storage or for stamping. Condemned blanks are also dumped into tote boxes for return to process weigh section for subsequent delivery to the Melting and Refining Division.

The press room is equipped with 29 presses, all 29 of which may be used for stamping any denomination from cent to dollar. All 29 presses may be used for dual stamping for cents and dimes. Feeding equipment is on hand for dual stamping of nickels on 9 presses, dimes on 12 presses, and cents on 29 presses. This equipment is probably sufficient for most any combination coinage program which might be called for. Production of cents, nickels and dimes is 100% by dual stamping. Blanks are delivered to press room balcony by process weigh room in gondolas. These gondolas are dumped into chutes extending into the press room from the balcony. There are six chutes on East side of room servicing 12 presses and 4 chutes on West side of room to service 10 presses. Blanks are drawn from chutes into circular screen bottomed containers supported on racks equipped with castors for movement to presses. Containers hold about 2,500 ounces of blanks which are fed by scoop to feederhoppers on the presses. Stamped coins at presses are handled in coin boxes. These boxes of coin are dumped into tote boxes for subsequent handling. Minor coin goes directly to the counting section without process weighing. Silver is weighed in the process weigh room and then routed to the counting section. Four of the presses on the East side of the press room are equipped with enlarged press feed hoppers and coin catch traps. Coin from these presses is dumped into tote boxes on dollies at the side of the press. Full tote boxes of coin are rolled a short distance to a position under an electric hoist and are lifted from the dollie and dumped into standard tote boxes on hand trucks. Similar equipment is to be installed for the remainder of the presses in the press room.

The counting section is equipped with 10 Abbott counting machines placed on steel stands, 2 to a stand with an elevated hopper feeding into syntron vibrators which feed each counting machine. Minor coins for counting comes directly from the press room while silver coin comes from the process weigh room to the counting section. Coin is counted directly into bags, $50.00 denominations of silver (#1 bags). Two counting machines have a common portable sack sewing machine used for sewing closure of the bagged bronze coin instead of sealing the bags. Bagged coin is weighed in drafts of 15 bags for bronze and 10 bags for each of the other denominations using a predetermined tare weight for the weight of bags and seals or thread. A 10,000 ounce scale is used for weighing bagged coin. Hoppers on counting machine stands are

filled from tote boxes using a bridge crane for dumping. Bagged coin for delivery to the Cashier is stacked on pallets placed on hand trucks, 60 bags on cents, 40 bags on nickels and 45 bags on silver.

The process weigh room is equipped with one 10,000 ounce scale and 3 bridge cranes for handling weigh tubs on and off the balance. The standard draft for all denominations is 10,000 ounces. Blanks to the presses are controlled in locked gondolas.

METHOD OF RECORDING LIFE OF DIES

An individual die card is issued with each die as it is put into service - information shown on each card as follows: denomination, die number, date issued, die setter, remarks, date retired, by whom retired and by whom checked. The record cards are kept in a numbered rack from the time each die is issued until it is retired.

When a new set of dies is put into service the required information is entered on the record card by the die setter and checked by the foreman. The counter on the press is set at zero and the cards are placed in the rack. When the dies are retired the die setter enters the pieces struck as shown by the counter and he is checked by the foreman. If any of the dies are retired before the rest, entries are made on the cards just the same and the cards for the retained dies are returned to the rack. The counter on the press is turned back to zero and the additional pieces struck entered on the card when the die or dies are finally retired.

Each day the foreman of the press room turns in the record cards for all dies retired to the Coining Division office where the permanent record of all coinage dies is kept in the Record of Coinage Dies, Form 864.

As shipments of dies are received from the Philadelphia Mint the die numbers are posted in the permanent record. After the dies are used, the number of pieces struck by each die and the date retired are entered from the individual die record card as received from the foreman of the press room.

An intermediate posting to a loose-leaf form is made for convenience in compiling a monthly die report. The quarterly die reports are made from the permanent die record.

BM - 35
(1/75)

DEPARTMENT OF THE TREASURY
WASHINGTON, D.C. 20220

OFFICE OF
DIRECTOR OF THE MINT

## PERCENTAGE COMPOSITION OF METALLIC ELEMENTS

## PRESENT IN CURRENT U. S. COINS

The percentage composition of the metallic elements present in current U. S. coins follows:

| | | |
|---|---|---|
| One-Cent | - | 95% copper, 5% zinc |
| Five-Cent | - | 75% copper, 25% nickel |

Prior to the passage of the Coinage Act of 1965, all of the circulating U. S. silver coins - the dollar, half dollar, quarter and dime - were composed of a silver-copper alloy containing 90% silver and 10% copper.

The 1965 Coinage Act removed all silver from the dime and quarter. These are now "clad metal" or "bonded" coins. The outside layer is composed of a 75% copper and 25% nickel alloy. The core contains pure copper. The outer layer is bonded to the core, and represents 1/6th of the total thickness of the coin. If the coin were to be melted, the composition would be 8.33% nickel and 91.67% copper.

The silver content of the half dollar was reduced from 90% to 40% in 1965, by the same Act, and became a "clad metal" coin. The outside layer is composed of a silver-copper alloy containing ~~20%~~ 40% silver and ~~80%~~ 60% copper. The outer layer represents a little less than 1/6th of the total thickness of the coin. If the coin were to be melted, the resulting metal would be 40% silver and 60% copper.

Coinage legislation approved December 31, 1970, removed all silver from the half dollar, and also from the silver dollar (the last of which had been minted in 1935). Now, none of our circulating coins contain silver. All are the clad metal and contain 75% copper and 25% nickel, as described above.

Dollar coinage was resumed in 1971, and those now circulating bear the Eisenhower likeness. Also a layered, or bonded piece, the outside is a 75% copper and 25% nickel alloy with a core of pure copper. Melted down, it would contain 8.33% nickel and 91.67% copper.

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# Clad Versus Alloy Dollar

The unanimous opinion of officials of the Denver Mint to the effect that the new Eisenhower Dollar should be made of cupro-nickel alloy, rather than cupro-nickel clad, is based on the following facts:

1. In the present instance, as opposed to the situation in 1965, it isn't necessary to go to clad since we do not have the vending machine problem. The situation is entirely different from that which confronted us in 1965 when we went to clad coins for dimes, quarters and halves. At that time, we had to develop coins which would circulate side by side with the old coins and be equally acceptable to the vending machines which were engineered to the old coins.

2. The clad coin is less desirable because of the exposed red edge and it will be much more pronounced with the thicker half dollar and dollar coins.

3. The clad coin is much more expensive. When we first went to clad coins, the cost of producing the clad coins was approximately six times as much as the former cost of producing alloy coins. Now that the suppliers have more experience with clad and we are purchasing strip in a buyers market, rather than a sellers market, the cost is down to approximately three times as much.

4. The already perplexing problem of how to get rid of large amounts of undesirable 8 1/3 % nickel scrap will be multiplied by production of both the clad half dollar and the clad dollar. If they were made of cupro-nickel alloy, it would not only preclude the compounding of an already existing problem, but would provide some relief for the present problem by providing an outlet for this type of scrap.

5. There is some question as to whether or not the required thicker strip will bond as good as the thinner strip.

BM-16
(2/75)

DEPARTMENT OF THE TREASURY
WASHINGTON, D.C. 20220

OFFICE OF
DIRECTOR OF THE MINT

## COINAGE OPERATIONS

United States 5-cent coins are cupro-nickel pieces composed of 75 per cent copper and 25 per cent nickel. Our cents are bronze and contain 95 per cent copper and 5 per cent zinc.

Pure metals, accurately weighed and combined to produce these alloys are melted in electric furnaces to form a homogeneous mass and are cast into coinage ingots in water-cooled molds.

The ingots are passed several times through rolling mills which reduce them to long strips of the exact thickness or gauge required for the denominations being produced. The strips are fed into high-speed punch presses which cut planchets or blanks of the proper diameter. Both the cupro-nickel and bronze planchets are softened by annealing in a special type furnace, cleaned, and dried.

Planchets for the 5-cent and 1-cent coins are put through an edge-rolling operation which produces a raised rim on them. With a single stroke, the coining press stamps the designs of both the obverse and reverse dies on the planchet.

The dime, quarter, half dollar and dollar are manufactured from strips composed of three layers of metal bonded together and rolled to the required thickness. This is called "cladding." The face is 75 per cent copper and 25 per cent nickel and the core is pure copper, which is visible on the edges of the coins.

Initially, all clad material was purchased from outside manufacturers since the Mint did not have the capability of producing clad strip. The Mint has since developed this capacity and now produces a large portion of the clad strip in-house. The three strips to be bonded are softened in large coil annealing furnaces, carefully cleaned, wire brushed, and are rolled together under high pressures. The

clad strip is then rolled to final blank thickness. From this point forward, the manufacturing processes are the same as for the 5-cent and 1-cent coins. The edges of the dimes, quarters, half dollars and dollars are reeded. This familiar element is also produced as a part of the stamping operation.

All denominations are inspected, then counted and bagged preparatory to shipment to the Federal Reserve banks. Dimes, quarters, half dollars and dollars are sacked $1000 per bag for each denomination; nickels are sacked $200 per bag, and cents, $50 per bag.

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# OPERATIONS INVOLVED IN THE PRODUCTION OF COINS AT THE DENVER MINT

The Denver Mint normally produces approximately 20,000,000 coins per day. This amount decreases directly in proportion to the number of larger coins ($1/4, $1/2 and $1) being produced. In addition, the Mint manufactures coin and/or blanks for various foreign countries.

The six (6) steps involved in the production of coins are (1) Materials Receiving and Shipping, (2) Blanking, (3) Annealing and Cleaning, (4) Upsetting, (5) Stamping, and (6) Counting and Bagging.

(1) Materials Receiving and Shipping

The Mint purchases metal strip in coiled form from contractors. The coils are shipped on wooden pallets and unloaded from trucks with forklifts. The coils are removed from the pallets, weighed, and stored by the blanking presses. Chopped scrap is boxed and loaded on trucks for return to the strip suppliers.

(2) Blanking

Fifteen inch wide strips of specified thickness, in coil form to save space and permit easy handling, is processed through punch presses; this produces planchets (blanks) for future processing into coins. The remaining "web," after the blanks are punched out, is chopped up into fine pieces by a chopper attached to the exit end of the punch press. The blanks are then weighed and transported to Annealing.

(3) Annealing and Cleaning

The blanks are annealed and cleaned in one continuous piece of equipment. The blanks pass through a high temperature annealing furnace for the purpose of making them soft enough to receive the impression of the coinage dies during the later stamping operation. The blanks are washed, rinsed, and dried; they are then riddled or screened to remove cutouts and small pieces of scrap.

(4) Upsetting

The annealed and cleaned blanks are next put through upsetting (rimming) machines where the edges are rolled smooth and slightly raised. The amount and type of upsetting, that is, the height, shape and cross-section of the raised

edge, bears a distinct relationship with the quality of the finished coin and is necessarily varied in accordance with the design of the particular coin being produced. Actually, the edges of the blanks are upset for three reasons: First, to give them a smooth edge; second, to provide an additional amount of metal at the edge of the coin to take care of that part of the design which is on the edge, and; third, to enable the coins to be stacked evenly. After upsetting, the blanks are then transported to the pressroom or to storage.

(5) Stamping

The upset blanks are fed into automatic coin presses where, in the case of our most up-to-date presses, the impression is stamped on both sides of four coins for each stroke of the press. Each of these up-to-date presses will coin approximately 600,000 pieces per 24-hour day. Daily production from our older conventional presses is approximately one half that amount. The Denver Mint has 78 presses in operation. After the coins are stamped, they are passed over screens to remove oversize and undersize coins or blanks.

(6) Counting and Bagging

The final step in coin production is that of counting and bagging the finished coin. Here, metered counting machines are used to count and put a pre-determined number of coins in a bag attached to the exit end of the machine. All filled bags of coin are sewed and delivered to the Cashier for storage in vaults and ultimate shipment to Federal Reserve Banks.

Excerpt taken from HE PIROTECHNIA OF VANNOCC. BIRINGUCCIO"

Translated by Smith & Gnudi

THE THIRD CHAPTER

"DISCOURSE AND ADVICE ON HOW TO OPERATE A MINT
HONESTLY AND WITH PROFIT"

First Edition 1540

Since I have told you of the distillation of waters and the extraction of oils from things - all ingenious and useful processes - I wish to continue to speak of the arts. I am reminded that I first wish to write down for you the discourse that I made to you on another occasion a few days ago concerning the operation of a mint, so that if you have lost it from your memory (and this would not be surprising since you have had no practice in it) you may repossess if if you should need to practice it or even to talk about it, and if you find yourself in this activity it may not be new to you.

I told you, as I believe you will remember and so again I repeat, that a very great and constant diligence is required by one who wishes to operate a mint well, or to have it operated, because it has many parts which it is necessary for anyone who enters this work to understand very well; indeed, if he wishes that all the work of his helpers be done well, he will have to do it himself. And if it were possible, he should have a hundred hands and a hundred eyes together, and at the same time should be in different places, because some loss often occurs in what is handled because of the carelessness of the workers or because of their little real trustworthiness. It is understood that such things require great hard labors and many kinds of knowledge. The material handled in this work is most often either gold or silver all ready to be spent, and these things are very attractive to those who handle them. In addition to being made into pieces of money likely to disappear, it is very easy to lose, and whatever part is lacking for any reason whatever (132v) brings detriment and loss to the patron since it is a thing of value.

Therefore, in short, anyone who wishes to exercise this art well, without being fraudulent therein, must watch the weights with all care because the essence of this art is naught but the division of a quanity of weight into many exactly defined pieces and the alloying of gold by carats and of silver by leghe, exactly established in accordance with what the price grants you as remedy.* If through negligence you exceed in perfection you harm yourself without benefit to anyone, and if you fall short, you fail in your duty, and you become known by most people as a disreputable person. Very severe and abusive punishment is often dealt for this in addition to the disgrace. If you choose to proceed in the right way as duty dictates, the earnings from this work are very slight; yet, because it is in many small parts done often, and because as soon as it is finished it has its profit with accumulates, the many small parts

* The terny "remedy" is applied to the amount allowed for the legitimate and unavoidable loss in the coining operation, and also to the plus and minus tolerances in both assay and weight. It was frequently regarded as a source of profit for the mint masters, and, as Biringuccio says, was sometimes used as the means of paying the

money in lieu of other fees.

multiply in such a way that a great profit results therefrom at the end of the year. If you wish to do it well, it is necessary that you do as much as possible yourself because, in addition to earning yourself what your helpers would earn, you avoid the mob of hucksters and their greed.

In short, use care in whatever operation you do or have done, especially in the weights, being careful both in giving them out to be worked and in receiving them back after they have been worked. Likewise in buying gold and silver, whether base or fine, open your eyes well, not only to the deceptions that may be made in the thing itself, but also - with assays, trials, and touch needles - to its fineness in carats and leghe. Do not hesitate to satisfy your mind in knowing how much fine there is in the quanity that is offered you. Then in cementing gold or in refining and parting silver, always keep your balance and your pen at hand for tallying, having respect for no one in recognizing the error in every process, if there should be one.

You are to do the same with your helpers; first with the casters, next with the stampers,* and then with the workmen; and see that you check often with the weight adjusters, because this is very important, and finally with the coiners. As I have said, it is necessary not to be careless in any part nor to trust yourself to the knowledge or goodness of any person, or in their hands, if you can avoid it, but, as I have told you, to do everything yourself that is possible.

Therefore it is necessary to be a clever person with an alert mind. One must be a good arithmetician so as to make no mistakes in reckoning, to his own or others' loss. He must also know how to assay silver and gold well or else have someone who does it faithfully and carefully and does nothing but this. He must also know how to melt and refine and must understand the method of making cupeling hearths appropriate to the materials, for much fraud can be done with these as well as in not refining well. It should be established that the waters do not diminish when granulating auriferous silver, and that the parted gold is wholly recovered. Even though the weight of each one agrees with the assay, if (133) your assayer happens to be also your parter, he can do things to his own great benefit. You must likewise watch the one who melts the parted gold and silver in order to reduce it into one body, and also the one who cuts the plates for making the money. Thus, from one kind of work to another, it is necessary to remain with the eyes always open and to keep the balance and pen always in hand, for, as I have told you and repeat again, every vigilance and care must be observed in these things. You should compare your weights often in order to satisfy your own mind, if for no other reason, for it is clear that even the mice and birds willingly carry away gold.

Now in order to come to the various parts of this procedure, I shall first tell you that relating to gold. Having brought it by

* stempenini: these seem to be the men who flatten the blanks and are distinct from the coiners proper (coniatori) who strike the coins between engraved dies as the final operation, which Biringuccio passes over without description.

computation exactly to the carat (minus the amount of fineness that is the remedy granted to you as clear profit by the prince), the quantity that you have or that you wish to work is taken, melted, and cast in bars. These bars are extended with a hammer on a flat anvil and are all reduced to a certain uniform thinness. These are cut crosswise from the length into little squares like dice so that they turn out a little heavier than the money you wish to make. Then they are cut into pieces all of the same size with a pair of large cutting pincers. They are then annealed in a little frying pan or something else with a red-hot fire or charcoal, after which they are given to the stampers and in one or two blows are all flattened out one by one on a stone. Thus made, they are smoothed by the workers and brought almost to the size that they are to have. In this shape they go to the adjusters who carefully reduce them to the exact weight without any excess. Then they are returned in this condition to the workers who finish smoothing them and rounding them by hammering on the edges. Thus made, they are heated and thrown into a common blanching liquor made with powdered tartar, salt and water, or urine. In this way the gold is cleaned and brightened and then the pieces are washed well with clear water. When dried, they are sent to the dies* and thus coined they are finished so that they have only to be spent.

Silver money is made in a way similar to that of gold, after you have converted the quantity that you wish to work to the proper alloy. There is no difference in the procedure of working except that silver is poured into plates instead of bars. These are cut with large pincers into little bars, and from bars into small squares. In flattening it, more blows are needed since it is a harder thing. Also, some rock alum is put in the blanching liquor in addition to tartar and salt because they whiten better.

There are some who, to avoid having the little squares flattened out by the stampers, have the bars of this silver or gold passed through a wire-drawing plate,* drawn out with a little windlass. In this way they bring it to a definite size so that, when cut and then smoothed and rounded, they come out to almost the exact weight, and the worker has only the labor of hammering the edges and finishing the smoothing. There is even less (133v) work for the workers and the adjuster when the bar is cut with a round punch which brings them almost to the exact size with a single cut.

Copper money is not really made for the copper it contains, but for the silver that is added as alloy. Since it is not always large pieces of money that are spent and since the value of a quattrino

* stampa; perhaps "to the press", but unlikely.

* trafilla. This method of drawing the plates through a die, mentioned by Leonardo da Vinci, is an interesting and probably direct antecedent to rolling. The first recorded use of rolls was probably in 1532 in Nuremberg. The other important mechanical aid to minting, the screw press, was known in Biringuccio's time. Cellini (Trattati dell'oreficeria e della scultura, Florence, 1568) says that he used a screw press in executing more than one hundred medals for Pope Clement VII(1523-1534).

/ This "copper" is in reality the base silver-copper alloy commonly called billon. It was extensively used on the Continent for coins of small denominations.

7 The quattrino was a billon coin, weighing 0.65 grams, about 17 mm. diameter and worth 1/40 of a giulio. Other coins mentioned by Biringuccio are the giulio (page 430) and the grosso (page 405).

or two in silver would be so small a piece that it could be not conveniently used if one had a quantity to handle, it has therefore become customary to mix with it that quantity of copper which is added in order to make the piece larger. In this also, after the quantity that you wish to work into money has been taken, it is melted in a lade or large crucible and alloyed by adding to every pound of fine copper enough fine silver - usually one ounce, three pennyweight for every pound - to give it the value you wish the resultant money to have, subtracting, however, the amount that is to cover the expense, or that is promised to you by the prince. When this has been melted, it is cast in hot iron plates greased with fat or with a mixture that is made to cause it to run better, which I shall also teach you. Then the said thin cast plates are taken and cut with the large cutting pincers, making bars as long as can be gotten from the plates. Then they are cut crosswise and little squares like dice are made, large enough to contain the weight of the quattrino. Now made in this way, these pieces are annealed with charcoal and when annealed are all flattened out with two or three hammer blows by one or more stampers. Then they are annealed again and you proceed with these in a way similar to the others described to you up to the point where they are to be finished. But now the end varies according to the places where such money is current, because some prices want them to appear white and some black. Those coins that are to appear white are made to appear white by means of the blanching liquor. Those that are to appear black are made so in a large frying pan perforated like a sieve, in which they are put with burning charcoal and frequently tossed up many times so that they may be in the air and may be heated without burning. Thus the silver if forced to cast out its blackness as all base silvers always do. When the coins made in this way have been freed of charcoal and cooled, they are sent to the dies, and so reach their final end.

Now since I have advised you concerning all the precautions that I could, I do not wish to omit this additional one - that you take every care to have good masters who make good and beautiful master dies* for you. For these almost always cause people to praise the coin together with those who have made it and those who have had it made, and it is a thing that everyone approves as good and holds that much more dear.

Now, concerning the skill and procedure necessary for this practice, I shall repeat in general: First, it is necessary to know well how to assay, to cement, to make (134) cupeling hearths, to part, and to make all kinds of melts when necessary. I do not repeat

* Stozzi

them again, since I have previously told you of these things in the part on ores in the Third Book.

I now wish to teach you the dressing that I told you before is for greasing the plate moulds so that the molten copper cast therein may spread out and become thin. If you could have strong soft-soap scum it would be better because it is softer; washing lye suds are also good. In a quantity of one of these things put enough cow dung to make it as thick as a sauce. Then pass it two or three times through a sieve so that it becomes very fine. Furthermore, put half a pound or more of the soap used for washing clothes in every three or four bowlfuls of this mixture; if you put in more it will be that much better. Alternatively put in old tallow or some other grease. When your moulds have been very well heated, thoroughly grease them with this composition after it has been properly compounded over the fire, and cast in them at your pleasure. By greasing them with oil of sublimate you can also make every casting run and come out well, but it is a thing that requires excessive expense and labor to do.

Production of Coins